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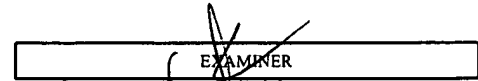
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/603,147 06/23/2000 John T. Moore MI22-1443 3541

21567 7590 07/03/2002

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EXAMINER
KIELN, ERIK J

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 07/03/2002

14

Please find below and/or attached an Office communication concerning this application or proceeding.

NV

Office Action Summary	Application No. 09/603,147	Applicant(s) MOORE ET AL.	
	Examiner Erik Kielin	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 June 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 64-66, 68, 70-77, 79-81, 83, 84 and 87-94 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 64-66, 68, 70-77, 79-81, 83, 84 and 87-94 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) ☐ All b) ☐ Some * c) ☐ None of:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) <u>11</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6/5/02 has been entered.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 64-66, and 76, 77, 79-81, 83, 84 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Regarding independent claims 64 and 76, Applicant's specification does not have support for the terminology in the limitation describing the sidewall spacers as "being essentially free of nitrogen" as presently claimed. Rather the specification specifically points out that the sidewall spacers maybe silicon nitride (p. 20, lines 14-17), which clearly incorporates nitrogen. Consequently, the terminology chosen is not co-extensive in scope with the specification; rather, it is broader in scope.

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If Applicant chooses to exclude nitrogen from the sidewall spacers, Applicant should use close-ended language such as “the sidewall spacers consist of silicon, oxygen, and carbon,” a limitation for which there exists support from the specification (ibid.) which is co-extensive with the specification. Otherwise, Applicant may file a continuation-in-part application.

The remaining claims are rejected for depending from the independent claims 64 and 76.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 87-94 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

6. Claims 87 and 88 recite the limitation "wordlines" in lines 6, 8, and 10 of claim 87 and line 2 of claim 88. There is insufficient antecedent basis for this limitation in the claim. It appears that the “wordlines” refers to the “pair of conductive gates” in being consistent with the specification and the other groups of claims.

The remaining claims are rejected for depending from the independent claim 87.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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8. Claims **68**, **74**, **75** and **87-89**, **92-93** are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of US 5,935,873 (**Spuler et al.**).

AAPA clearly discloses each of the features of the DRAM including a semiconductor substrate **12**, the three nodes **14**, **16**, **18** in gated electrical connection via wordlines **20**, **22** with sidewalls **28**, **30** (i.e. the wordlines are the conductive gates controlling the connection between the capacitors and the storage nodes); capacitor constructions **36**, **38** formed in the openings of and directly against the insulating layer **34** and directly against the substrate **12**; bit line contact **46**; the etch stop **32** formed over, along, and proximate the wordlines and extending along and against a portion of the storage node (first electrode **40**). Each capacitor construction comprises a storage node (first electrode) **40** formed of conductively doped polysilicon (specification, p. 4, lines 16-18), dielectric **42**, and second electrode **44**. (See Prior Art Figures 1-4 and specification, section entitled, Background of Invention" -- especially pp. 5-8. Compare especially **AAPA** prior art Fig. 1 with non-prior art Fig. 7.)

AAPA does not state that the etch stop layer **32** contains carbon, i.e. is the "carbon-containing layer" which comprises "from about 2% to about 20% carbon." or more specifically silicon, carbon, and nitrogen, as further limited by instant claims **74**, **75**, **89**, **92**, and **93**.

Spuler teaches the benefits of forming an etch stop layer **22** comprising carbon, specifically carbon-doped silicon nitride by using known deposition methods or by implantation of carbon into silicon nitride *to provide good etch selectivity* relative to an oxide layer **30**, deposited thereover. (See col. 2, l. 39 to col. 3, l. 35.) The carbon content is 1% to 50% -- preferably 10% to 30%.

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It would have been obvious to one of ordinary skill at the time of the invention to use the etch stop layer of **Spuler** in the **AAPA** production and device for the reasons in **Spuler** or, more specifically, that the carbon-doped silicon nitride in the etch stop layer provides better etch selectivity relative to oxides than silicon nitride alone, as is also, coincidentally, taught by the instant specification.

9. Claims 76, 77, and 79 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of US 5,935,873 (**Spuler et al.**) and **Wolf, et al.** Silicon Processing for the VLSI Era, Vol. 2-Process Integration, Lattice Press: Sunset Beach CA, 1990, pp. 354-355.

Regarding claim 76, the prior art of **AAPA** in view of **Spuler**, as explained above, discloses each of the claimed features except for indicating that the sidewall spacers are "essentially free of nitrogen."

The basic textbook of **Wolf** teaches that typical sidewall spacers are formed from oxides which are, therefore, essentially free of nitrogen because oxides contain oxygen, not nitrogen (i.e. nitrides).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use a known material as taught by **Wolf** to form the sidewall spacers in **AAPA** because the selection of a known material (oxide) based upon its suitability for an intended purpose (sidewall spacers) is *prima facie* obvious in the absence of unexpected results. No unexpected results are presently of record.

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Regarding claim 79, **Spuler** also teaches forming the etch stop **22** adjacent the gate (wordline) structure **12, 14, 16** (col. 2, ll. 8-24) which inherently serve as sidewall spacers. It would have been obvious to one of ordinary skill at the time of the invention to form the etch stop adjacent the wordlines in order to provide protection to the gate structure during etching, as this is desired in both **Spuler** and in the **AAPA**.

10. Claims **87, 88, and 90-93** are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of JP 10-223758 (**Nobuhisa**).

AAPA, as indicated above, teaches all of the features of the claims except for the indicating that the etch stop layer comprises silicon, oxygen, and carbon (claim 53) or silicon, oxygen, nitrogen, and carbon.

Nobuhisa teaches the benefits of forming an etch stop layer **20** comprising at least one of (1) silicon carbide (2) silicon, carbon, oxygen, and (3) silicon, carbon, oxygen, and nitrogen by implanting carbon and/or nitrogen into silicon dioxide layer **4b**. Note that although, **Nobuhisa** teaches that SiC or SiCN is formed, it is held absent evidence to the contrary that oxygen is necessarily present because the carbon and nitrogen are implanted into silicon dioxide. (See paragraphs [0036]-[0039] and especially [0053] which states that both carbon and nitrogen are implanted; Figs. 4-6.)

It would have been obvious to one of ordinary skill at the time of the invention to form the etch stop of **AAPA** with the materials taught by **Nobuhisa** for the reasons in **Nobuhisa**, specifically to form an etch-resistant etch stop layer relative to silicon dioxide.

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11. Claims **68** and 70-75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of JP 10-223758 (**Nobuhisa**) and further in view of **Spuler**.

AAPA in view of **Nobuhisa**, as indicated above, teaches all of the features of the claims except for the indicating that the carbon content of the etch stop layer is from 2% to 20%.

Spuler teaches the appropriate amount of carbon in an etch resistant material for providing good selectivity relative to non-carbon containing dielectric materials is 1 to 50% or preferably 10% to 30%.

It would have been obvious to one of ordinary skill at the time of the invention was made to use the amount of carbon suggested in **Spuler** for the carbon resistant material taught in **Nobuhisa** for the etch stop in **AAPA**, for the reasons indicated in **Spuler**, for example, to give good etch selectivity and because **Nobuhisa** is not limited to any amount of carbon content except for that amount that gives the desired etch selectivity that **Nobuhisa** teaches which is the subject of the patent.

Further in this regard, although the carbon quantity is not exactly as claimed by Applicant, overlapping ranges are *prima facie* obvious in the absence of unexpected results. (See MPEP 2144.05.) The choice is obvious to optimize the amount of carbon to provide the best etch selectivity relative to a non-carbon-containing dielectric, according to the teachings of **Nobuhisa** and **Spuler**.

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12. Claims 76, 77, 81, 83, 84, and 89 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of JP 10-223758 (**Nobuhisa**) and **Spuler**, and further in view of **Wolf**.

Regarding claim 76, the prior art of **AAPA** in view of **Nobuhisa** and **Spuler**, as explained above, discloses each of the claimed features except for indicating that the sidewall spacers are "essentially free of nitrogen."

Wolf is applied as above.

13. Claims 87, 88, and 90-93 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's admitted prior art (**AAPA**) in view of US 6,136,700 (**McAnally** et al.).

The **AAPA** discloses all of the features of the instant invention, as noted above, except for indicating that the etch stop layer or sidewalls comprise (1) a material having carbon, (2) silicon carbide, (3) a material having carbon, silicon, and oxygen, (4) a material having carbon, silicon, and nitrogen.

McAnally teaches forming either or both the sidewall spacers **108** and etch stop **110** from the aforementioned compositions containing carbon to improve etch selectivity -- several of which are *free of nitrogen*. (Abstract; col. 3, lines 37-40; claim 3; col. 5, lines 10-43; col. 6, lines 25-31).

It would have been obvious to one of ordinary skill at the time of the invention was made to use the etch stop of **McAnally** for the etch stop of **AAPA** for the reasons indicated therein in **McAnally** as just noted.

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14. Claims **64-67**, and **68**, 70-75, and **76**, 77, 79-81, 83, 84, and 89, 94 are rejected under 35 U.S.C. 103(a) as being unpatentable over **AAPA** in view of **McAnally** and further in view of **Spuler**.

The **AAPA** in view of **McAnally** discloses all of the features of the instant invention, as noted above, except for indicating the specified amount of 2% to 20% carbon by weight is not taught.

Spuler teaches the appropriate amount of carbon in an etch resistant material for providing good selectivity relative to non-carbon containing dielectric materials is 1 to 50% or preferably 10% to 30%.

It would have been obvious to one of ordinary skill at the time of the invention was made to use the amount of carbon suggested in **Spuler** for the carbon resistant material taught in **McAnally** for the reasons indicated in **Spuler** and because **McAnally** is not limited to any amount of carbon except for that amount that gives the desired etch selectivity that **McAnally** teaches is the object of his invention.

Further in this regard, although the carbon quantity is not exactly as claimed by Applicant, overlapping ranges are *prima facie* obvious in the absence of unexpected results. (See MPEP 2144.05.) The choice of carbon content is obvious to optimize the amount of carbon to provided the best etch selectivity relative to a non-carbon-containing dielectric, according to the teachings of **McAnally** and **Spuler**.

Then regarding claims 64-66 and 94, while **McAnally** specifically provides sidewalls spacers which are "free of nitrogen," the thickness of the sidewall spacer in **AAPA** is not taught to be less than or equal to 500 angstroms and is not mentioned in **McAnally**. However,

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McAnally further indicates that a success of the invention is that “the invention allows for maximizing the area on the substrate that is in contact with a self-aligned contact” and that “the large contact area reduces the contact resistance and therefore increases the performance of the semiconductor device.” (See col. 2, lines 18-27.) And more pertinently, **McAnally** states, “Thus the use of an appropriate material for stopping layer 110 may allow the use of thinner films for the insulating film 106 and *the sidewall [spacers] 108*, which increases contact area and improves planarity.” (See col. 4, lines 42-45; Italicized emphasis added.) **McAnally** explicitly suggests minimizing the width of the sidewall spacers 108 which directly affect the contact area. The greater etch selective materials enable narrower or thinner sidewall spacers and etch stops because, as indicated in **McAnally**, the etch selectivity is greater between the carbon-containing materials and the non-carbon-containing materials. Accordingly, it would have been obvious for one of ordinary skill in the art, at the time of the invention to choose a sidewall spacer width of less than 500 Å in order to increase the contact area in accord with the **McAnally** invention and to thereby provide greater contact area in the **AAPA** contact. (Compare this with the instant specification paragraphs bridging pages 14-15 and 22-23, which conveys virtually the same concept as **McAnally**.)

Furthermore, the selection of the sidewall spacer thickness is *prima facie* obvious because it is a matter of determining optimum process condition by routine experimentation with a single variable, i.e. the thickness of the sidewall spacers within the implicit suggestion of **McAnally** which indicates that carbon-containing sidewall spacers and etch stops are more etch selective, which implicitly indicates that said materials can perform the same etch-prevention function with less of the material. (See MPEP 2144.05.)

Furthermore, as devices shrink, so do the dimensions of the features of each device according to Moore's Law. Accordingly, the choice of sidewall spacer thickness is merely a matter of routine optimization, as indicated above. Applicant has not recognized an advantage not already known in the art regarding the thickness of the spacers. In other words, one of ordinary skill would not continue to use sidewall spacers of a thickness used in a 1- μm rule, for devices in a 0.18- μm rule; instead, the size of all of the features, particularly the sidewall spacers, would be necessarily be scaled down.

Further regarding the width of the sidewall spacers, **Spuler** col. 2, lines 40-48, discloses the dimension of the opening, which is as small as 500 Å (0.05 μm) wide. It is clear then that the **Spuler** sidewall spacer portion of the etch stop layer are less than 500 Å; otherwise they would close off the contact. More specifically, the sidewall spacer portion of the etch stop layer is indicated to be 200 Å to 300 Å.

It would have been obvious to one of ordinary skill at the time of the invention to choose the sidewall spacer thickness in the **AAPA** to be less than 500 Å, depending upon the size of the opening between the wordlines, in order to optimize the sidewalls relative to the device being formed, and for the reasons just indicated above.

Double Patenting

15. Claims 70, 72, and 73 are objected to as being substantial duplicates (claims 70 and 72 are exact duplicates). Similarly, claims 74 and 75 and claims 83 and 84 are substantial duplicates. When two claims in an application are duplicates or else are so close in content that they both cover the same thing, despite a slight difference in wording, it is proper after allowing

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one claim to object to the other as being a substantial duplicate of the allowed claim. See MPEP § 706.03(k).

Response to Arguments

16. Applicant's arguments filed 6/5/02 have been fully considered but they are not persuasive.

Applicant argues that the indication of the claims above as duplicates is improper. Examiner respectfully disagrees. First the preambles do not distinguish the claimed limitations, accordingly they are **substantial** duplicates. Second, there exists nothing in the specification to suggest how "comprising" and "consisting essentially of" further distinguish the claimed limitation. Third, the claims read on each other based on the limitations which is the test for double patenting. Accordingly, the rejection is still considered to be proper.

Applicant's arguments with regard to the thickness of sidewall spacers are not considered persuasive for the reasons indicated above in the rejection.

Applicant's argument that "conductively doped silicon" is moot for (a) not being drawn to the subject of the invention which is the etch stop material, and (b) as noted in the rejections, **AAPA** discloses this.

Regarding any argument that the combinations are improper, Examiner respectfully disagrees. The suggestion to combine the references is noted above in the rejections.

Conclusion

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached at 703-306-2417. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin
June 27, 2002